SCT2460 Evaluation Board User's Guide

FEATURES

- Wide Input Range: 3.8V-36V
- Up to 6A Continuous Output Current
- 0.8V ±1%Feedback Reference Voltage
- Integrated 36mΩ High-Side Rdson and 13mΩ Low-Side Rdson Power MOSFETs
- 25uA Low Quiescent Current with Pulse Skipping Mode PSM at Light Load
- 100ns Minimum On-time
- Adjustable Soft-start Time
- 100KHz to 2.2MHz Adjustable Frequency
- Low Dropout Mode Operation
- Derivable Inverting Voltage Regulator
- EMI Reduction with Frequency Spread Spectrum FSS
- Over-voltage and Over Temperature Protection
- Available in 3mmx4mm QFN-10L Package

APPLICATIONS

- Automotive System
- USB Type-C Power Delivery, USB Charging
- Industrial and Medical Distributed Power Supplies

DESCRIPTION

The EV2460-B-04A Evaluation Board is designed to demonstrate the capabilities of SCT2460 high efficiency fully integrated synchronous step-down DCDC converter supporting up to 6A continuous output current from an input source from 3.8V to 36V. The SCT2460 offers adjustable switching frequency ranging from 100kHz to 2.2MHz with internal, which provides flexibility to optimize either efficiency or external component size.

The SCT2460, adopting the peak current mode control, supports the Pulse Skipping Modulation (PSM) with typical 25uA low quiescent current which assists the converter on achieving high efficiency at light load or standby condition.

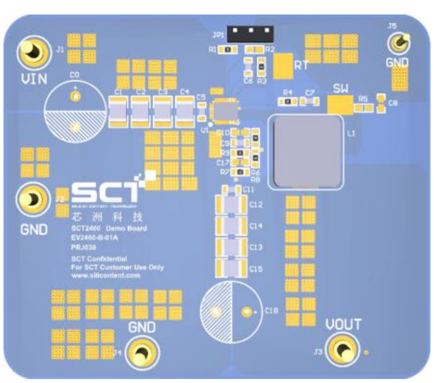
The device is available in 3mmx4mm QFN-10L package.

This user's guide describes the characteristics, operation and the use of the EV2460-B-01A Evaluation Module including EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

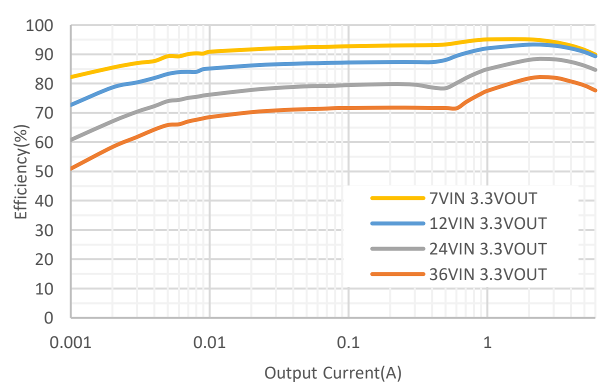
Board Number	IC Number
EV2460-B-01A	SCT2460

PERFORMANCE SUMMARY

Parameter	Condition	Value
Input Voltage	DC up to 36V	3.8V-36V
Output Voltage	Iout=0A~6A	3.3V ± 1%
Output Current	Continuous DC current	6A



EV2460-B-04A Evaluation Board Top View



SCT2460 Efficiency, Freq.=500KHz

QUICK START PROCESURE

Evaluation board EV2460-B-01A is easy to set up to evaluate the performance of SCT2460 synchronous step-down DCDC converter. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions:
   - J1,J2 : Connect the power supply to the input of converter.
   - J3,J4 : Connect the load to the output of converter.
   - JP1: Enable. Enable Jumper. Install ON shunt to connect EN pin to V_{in} through a 309KΩ resistor to enable IC. Install OFF shunt to disable IC.
2. With power off, connect the input power supply to J1,J2 V_{IN} connector and J1 GND connector. Make sure that the input voltage does not exceed 36V, and supports sufficient current limit. Turn on the power at the input.
3. Check the output voltage at J3,J4. The output voltage should be 3.3V typical. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, output voltage ripple, efficiency and other parameters.
4. To use the enable function, apply a digital input to the EN pin of JP1.
5. Users can place C0 if input wire is long and C18 for better load transient performance.

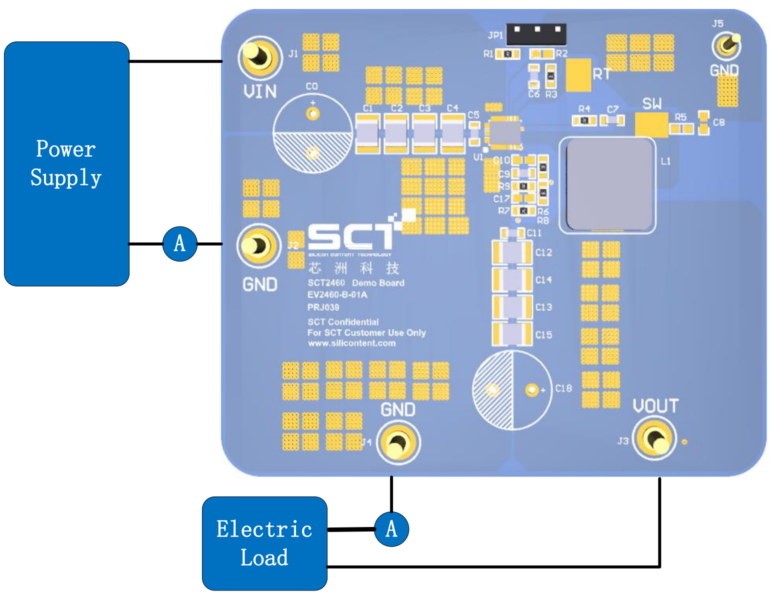


Figure 1. Power Supply, Load and Measurement Equipment Setup

NOTE: When measuring the voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across relevant capacitor of VIN or VOUT. See Figure 2 for proper scope probe technique.

Figure 2. Measuring Voltage Ripple across Terminals or Directly Across Ceramic Capacitor

SCHEMATIC DIAGRAM

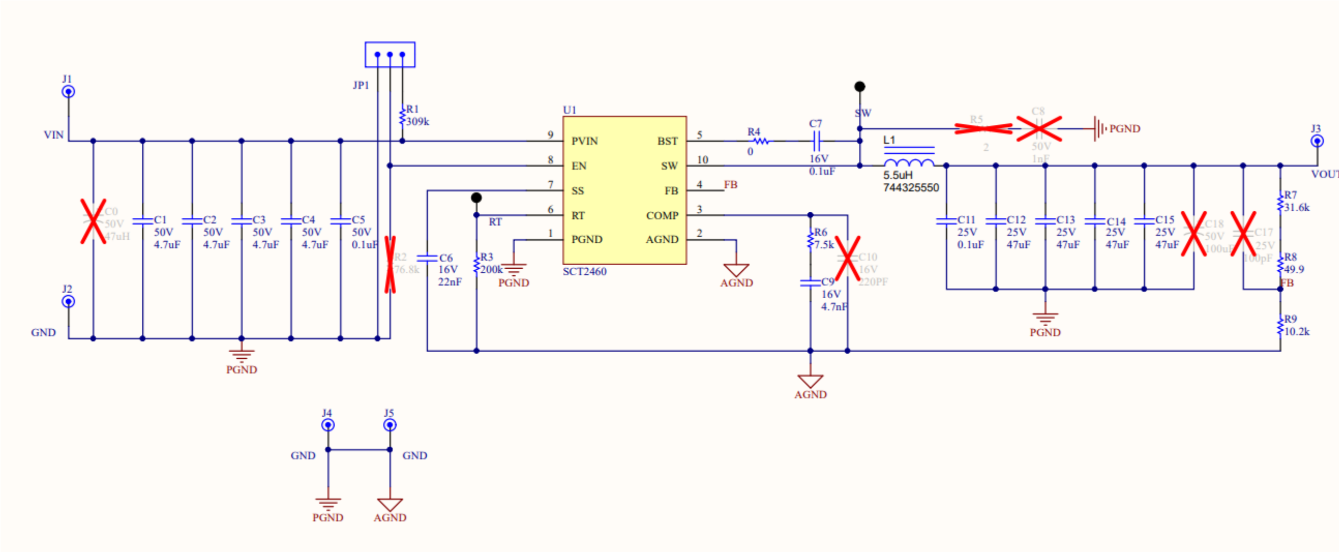


Figure 3. SCT2460 EVM Schematic

BILL OF MATERIALS

Table 2. SCT2460 EVM Bills of Materials

Footprint	Comment	Designator	Description	Quantity
QFN-10L	SCT2460	U1	SCT2460, 36V/6A Synchronous Buck Converter, 3mmx4mm QFN-10L Package	1
CONN_PEC03SAAN	613 003 111 21	JP1	Header, 100mil, 3x1, Tin plated, TH	1
	Terminal_2.1	J1, J2,J3,J4	Terminal	4
	Terminal_1.1	J5	Terminal	1
0603	Not Install	C0	WCAP-ATUL Aluminum Electrolytic Capacitors 100uF, 63V, Dimension 10x12.5	0
0603	Not Install	C18	WCAP-ATUL Aluminum Electrolytic Capacitors 220uF, 35V, Dimension 10x12.5	0
1210	885 012 209 048	C1, C2, C3, C4	CAP, CERM, 4.7 µF, 50 V,± 10%, X7R, 1210	4
0603	885 012 206 095	C5	CAP, CERM, 0.1 µF, 50 V,± 10%, X8R, 0603	1
0603	885 012 205 033	C6	CAP, CERM, 22nF, 16 V, +/- 10%, X7R, 0603	1
0603	Not Install	C8	CAP, CERM, 1000pF, 25 V, +/- 10%, X7R, 0603	0
0603	885 012 206 069	C9	CAP, CERM, 4.7 nF, 10 V,± 10%, X7R, 0603	1
0603	Not Install	C10	CAP, CERM, 220pF, 16 V, +/- 10%, X7R, 0603	0
0603	885 012 206 071	C7, C11	CAP, CERM, 0.1 µF, 25 V,± 10%, X7R, 0603	2
1210	885 012 109 011	C12, C13, C14, C15	CAP, CERM, 47 µF,16 V,± 10%, X7R, 1210	4
0603	Not Install	C17	CAP, CERM, 100pF; ; 50V, +/- 10%, X7R, 0603	0
'WE-HCI_1040	744325550	L1	Inductor, Shielded Drum Core, WE-HCI SMD Flat Wire High Current, 5.5 uH, Rate current IR 8.4A, Saturation Current ISAT 10A, DCR 0.0125 ohm,	1
0603	AC0603FR-07309KL	R1	RES, 309 k, 1%, 0.1 W, 0603	1
0603	Not Install	R2	RES, 76.8 k, 1%, 0.1 W, 0603	0
0603	NQ03WAF2003T5E	R3	RES, 200 k, 1%, 0.1 W,0603	1
0603	CRCW06030000Z0EA	R4	RES, 0, 5%, 0.1 W,0603	1
0603	Not Install	R5	RES, 10, 1%, 0.1 W, 0603	0
0603	0603WAF7501T5E	R6	RES, 7.5 k, 5%, 0.1 W,0603	1
0603	CT 0603WAF3162T5E	R7	RES, 31.6k, 1%, 0.1 W, 0603	1
0603	060300F499JT5E	R8	RES, 49.9, 1%, 0.1 W,0603	1
0603	CT 0603WAF1022T5E	R9	RES, 10.2k, 1%, 0.1 W, 0603	1
Keystone	5015	TP1	Test Point, Miniature, SMT	1

PRINTED CIRCUIT BOARD LAYOUT

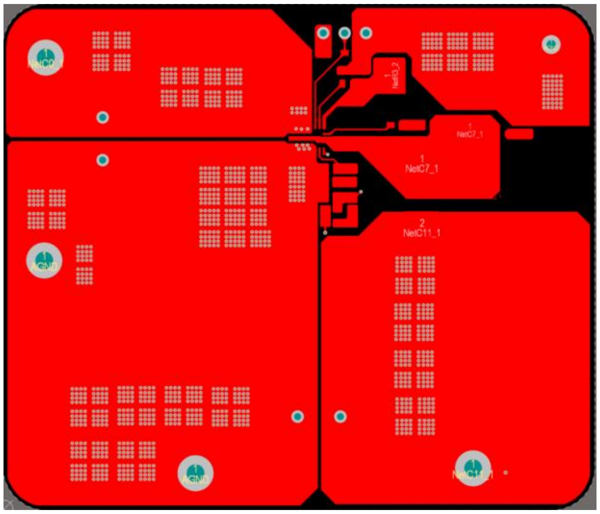


Figure 4. Top Layer

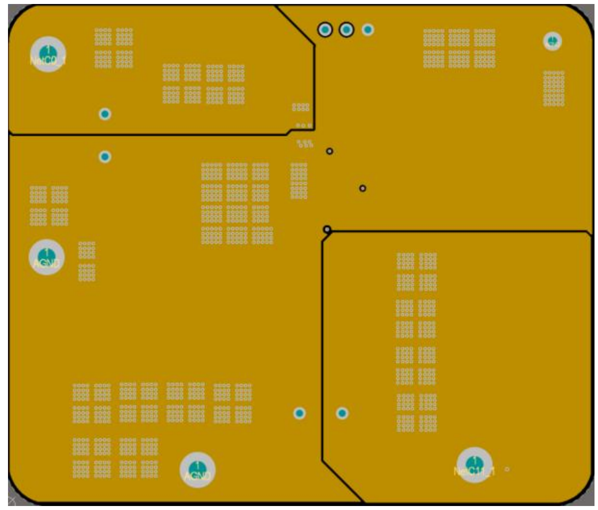


Figure 5. Internal 1 Layer

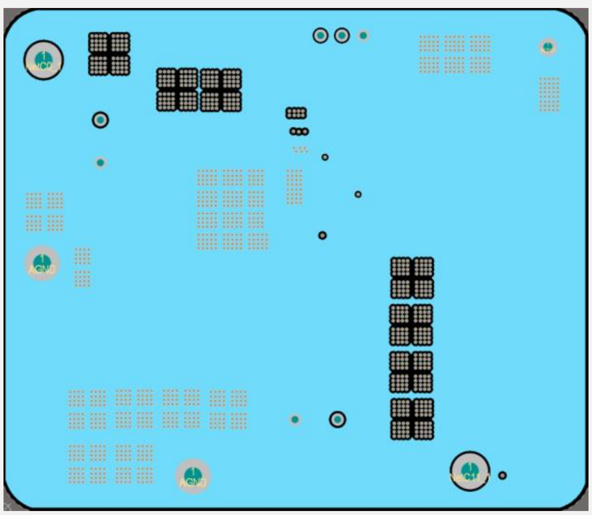


Figure 6. Internal 2 Layer

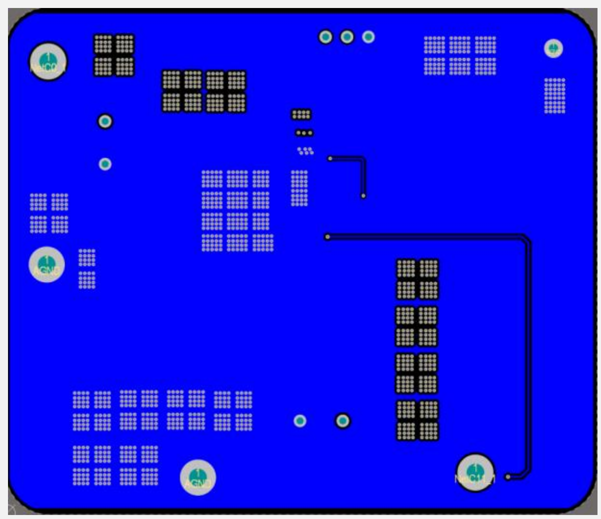


Figure 7. Bottom Layer

EVB TEST RESULTS

Vin=24V, Vout=3.3V, unless otherwise noted

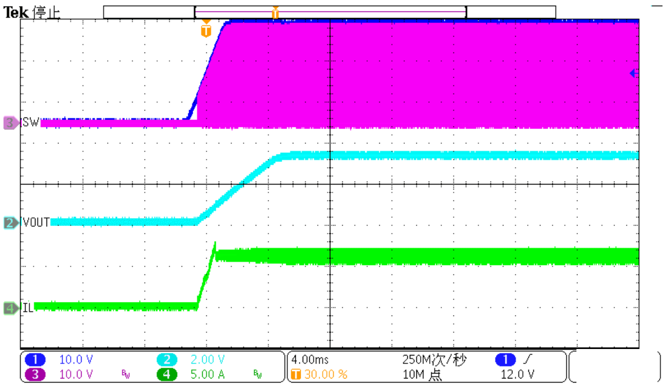


Figure 8. Power Up
(CH-1: Vin, CH-2: Vout, CH-3: SW, CH-IL)

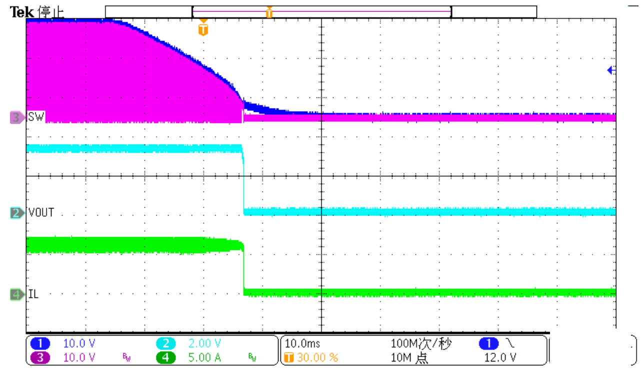


Figure 9. Power Down
(CH-1: Vin, CH-2: Vout, CH-3: SW, CH-IL)

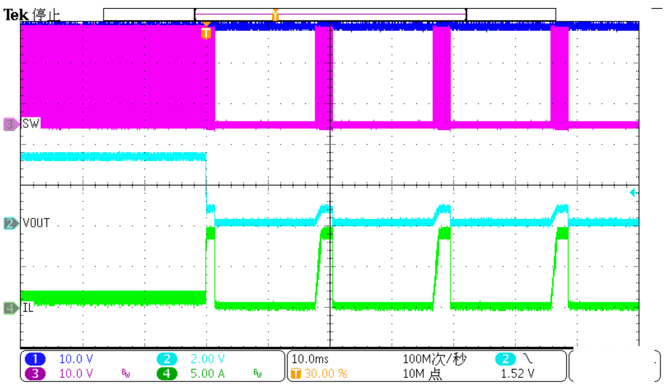


Figure 10. Startup at Output Hard-short
(CH-1: Vin, CH-2: Vout, CH-3: SW, CH-IL)

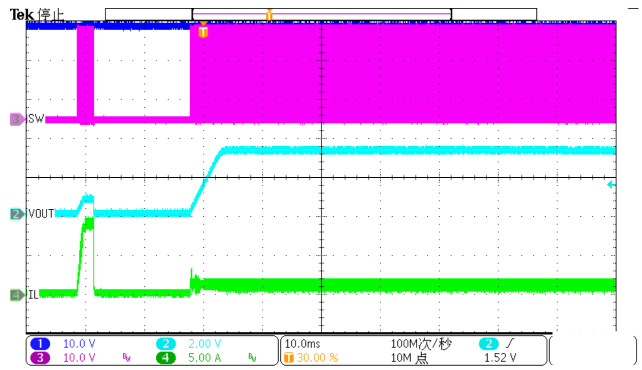


Figure 11. Output Hard-short and Recovery with 1A Load
(CH-1: Vin, CH-2: Vout, CH-3: SW, CH-IL)

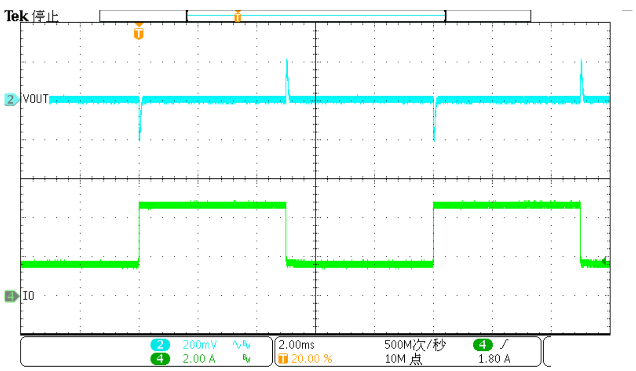


Figure 12. Load Transient
(1.5A-4.5A, SR=250mA/us, CH-1: Iout, CH-2: Vout)

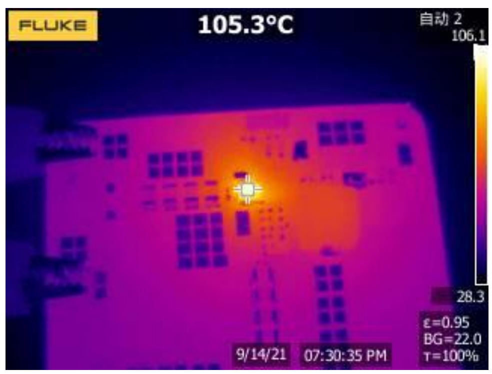


Figure 13. Infrared Thermal Image
(Vin=12V, Vout=3.3V, Iout=6A)

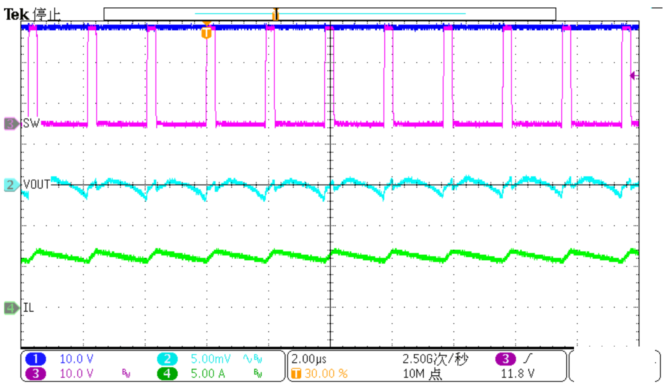


Figure 14. Output Ripple, PWM, Iout=6A
(CH-1: Vin, CH-2: Vout, CH-3: SW, CH-4: IL)

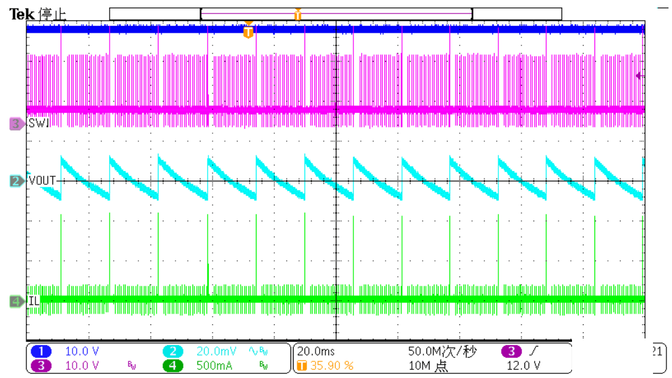


Figure 15. Output Ripple, PSM, Iout=0A
(CH-1: Vin, CH-2: Vout, CH-3: SW, CH-4: IL)

OPTIONAL MODIFICATION

Switching Frequency

The resistor R3 connected from SCT2460 RT/CLK pin to ground (Default 200KΩ) sets switching frequency of the converter. Use equation 1 to set a desired frequency.

Eq. (1)

$$R_3 = \frac{100000}{fsw\ (KHz)} \quad (1)$$

where:

- f_{SW} is the desired switching frequency

Table 3. R_3 Value for Common Switching Frequencies (Room Temperature)

fsw	R_3
200 KHz	500 KΩ
330 KHz	301 KΩ
500 KHz	200 KΩ
1100 KHz	90.9 KΩ

Programmable Soft-Start

The SCT2460 features programmable soft-start time to prevent inrush current during start-up stage. The soft-start time can be programmed easily by connecting a soft-start capacitor C_6 from SS pin to ground.

The SS pin sources an internal 3µA current charging the external soft-start capacitor C_6 when the EN pin exceeds turn-on threshold. The device adopts the lower voltage between the internal voltage reference 0.8V and the SS pin voltage as the reference input voltage of the error amplifier and regulates the output. The soft-start completes when the voltage at the SS pin exceeds the internal reference voltage of 0.8V.

The soft-start capacitor value can be calculated going with following equation 4. Attention should be taken here that the programmed soft-start time should be larger than 4ms.

$$C_6 = t_{ss} * \frac{3uA}{0.8V} \quad (4)$$

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Output Voltage

The output voltage is set by an external resistor divider R_5 and R_6 in EVM schematic. The values of R_5 and R_6 can be calculated by equation 3A minimum current of typical 20uA flowing through feedback resistor divider gives good accuracy and noise covering.

$$R_5 = \frac{(V_{OUT} - V_{REF}) \times R_6}{V_{REF}} \quad (2)$$

where:

- V_{REF} is the feedback reference voltage, typical 0.8V

Table 4. Feedback Resistor R_5 and R_6 Value for Output Voltage (Room Temperature)

V_{OUT}	R_5	R_6
1.8 V	12.7 KΩ	10.2 KΩ
2.5 V	21.5 KΩ	10.2 KΩ
3.3 V	31.6 KΩ	10.2 KΩ
5 V	53.6 KΩ	10.2 KΩ
12 V	143 KΩ	10.2 KΩ
24V	294 KΩ	10.2 KΩ

Under Voltage Lockout Threshold

The SCT2460 are enabled when the VIN pin voltage rises about 3.5V and the EN pin voltage exceeds the enable threshold of 1.18V. The device is disabled when the VIN pin voltage falls below 3.1V or when the EN pin voltage is below 1.1V. An internal1.5uA pull up current source to EN pin allows the device enable when EN pin is floating.

If an application requires a higher system under voltage lockout threshold, two external resistors divider (R1 and R2) in Figure 17 can be used to achieve an expected system UVLO. The UVLO rising and falling threshold can be calculated by Equation 3 and Equation 4 respectively.

$$V_{rise} = 1.18 * \left(1 + \frac{R1}{R2}\right) - 1.5uA * R1 \quad (3)$$

$$V_{fall} = 1.1 * \left(1 + \frac{R1}{R2}\right) - 5.5uA * R1 \quad (4)$$

where:

- V_{rise} is the rising threshold of Vin UVLO.
- V_{fall} is the falling threshold of Vin UVLO

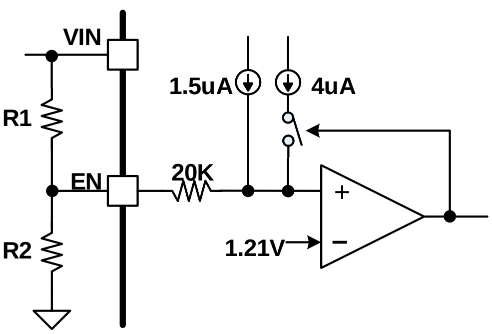

Figure 16. VIN UVLO Programmable by EN Dividers

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